

Estimating Methodologies Part 1

Module 4

**ESC Cost Core Training
Developed By**

**USAF ESC/FMC
Hanscom AFB, MA
Version 2 (Draft)
March 2000 (by ESC/FMC)**

**Revised
June 1993 (by Tecolote Research, Inc.)
August 1997 (by Tecolote Research, Inc.)**

**Apr 91
Version 1 (by ESC/FMC)**

Table of Contents - Module 4

7 Steps of the Cost Estimating Process	5
• In Order to Specify an Estimating Methodology, You Must...	6
• The Basic Types of Estimating Methodology	8
– The Analogy Methodology	9
• Type of Information Required for Analogy Methodology	10
• Credible Sources of Data for Analogy Methodology	11
• How to Develop an Analogy Estimate	12
• Sample Analogy Calculation	15
• When to Use the Analogy Methodology	16
• Key Tasks for an Analogy	18

- The Catalog Pricing/Vendor Quotes Methodology	20
• Type of Information Required for CP/VQs	21
• Credible Sources of Data for CP/VQs	23
• Special “Watch Areas” for CP/VQs	24
- Extrapolation From Actual Costs To Date	26
• When to Use Extrapolation From Actuals	27
• Special “Watch Areas” for Extrapolations	28
- Factor/Ratio Methodology	31
• Information Required for Factor/Ratio	32
• Credible Sources for Factor/Ratio	33
• Special “Watch Areas” for Factor/Ratio	34

- Grassroots/Bottoms-up Methodology	36
• Required Data & Credible Sources	37
• Special “Watch Areas” for Grassroots	38
- Manloading Methodology	40
• Components of Manloading	41
• Sources of Labor Rates	42
- Parametric Methodology	45
• Information Needed to Develop a Parametric Eq.	46 47
• Information Needed to USE a Parametric Eq.	48
• Special “Watch Areas” for Parametrics	

7 Steps of the Cost Estimating Process

1. Define and Plan

**2. Specify Estimating
Methodology**

3. Calculate -- Including What-ifs & Alternatives

4. Time Phase in Base Year Dollars

5. Inflate to Then Year Dollars

6. Wrap Up Documentation

7. Complete Final Reviews

In Order to Specify an Estimating Methodology, You Must...

- Determine preliminary levels of WBS
- Assess the availability of data
- Make preliminary selection of specific Estimating Methodology
 - Primary Methodology
 - Confidence Checks
- Collect and analyze data
- Finalize selection of Estimating Methodology

In Order to Specify an Estimating Methodology, You Must... (cont'd)

- Determine preliminary levels of WBS
- Assess the availability of data
- Make preliminary selection of specific Estimating Methodology
 - Primary Methodology
 - Confidence Checks
- Collect and analyze data
- Finalize selection of Estimating Methodology

The Basic Types of Estimating Methodology

- Analogy
- Catalog Prices/Vendor Quotes
- Extrapolation From Actuals
- Factor/Ratio
- Grassroots/Bottoms-up
- Manloading
- Parametrics

The Analogy Methodology

...is a comparison between two systems or efforts

- based on a relative scaling of a data point
- determination of how much more or less the new system will be relative to the historical data point

Type of Information Required for Analogy Methodology

- Cost, schedule, technical and quantity information for product/task you are estimating
- Cost, schedule, technical and quantity information for similar historical data points
- Quantitative “scaling factor” for cost impact of differences (most likely range)

Credible Sources of Data for Analogy Methodology

- The best sources of historical data are:
 - Contractor's accounting system
 - Reliable reports coupled with interviews of key contractor functional specialists
- The functional specialists must provide the relative scaling factors.

How to Develop an Analogy Estimate

- ✓ Accomplish the Define & Plan Step
- ✓ Identify cost drivers
- ✓ Assess availability of data and technical experts

How to Develop an Analogy Estimate

- ✓ Obtain specific technical, schedule & quantity data of all cost drivers.
- ✓ Obtain actual costs for similar historical data points.
- ✓ Segregate actual costs into recurring & non-recurring - when applicable.

How to Develop an Analogy Estimate

- ✓ Normalize costs of historical data points
- ✓ Obtain most likely range for “relative scaling” factors

Sample Analogy Calculation

Cost (New) = Cost (Old) x Relative
Scaling Factor x Manufacturing
Scaling Factor

= \$3M (BY91) x 1.25 x 0.80

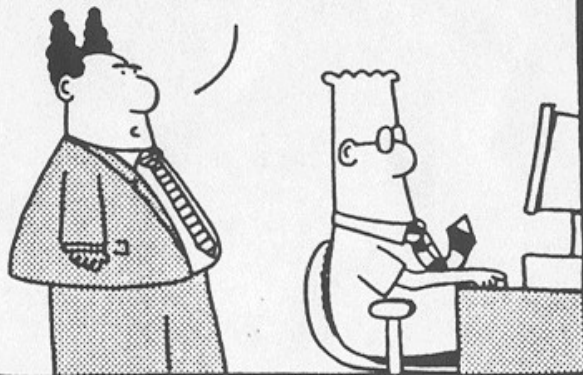
= \$3.75M x 0.80

= \$3M

When to Use the Analogy Methodology

- At any phase of the program
- For any WBS element
- Cost drivers must be known
- Obtain all data required from credible sources

WE JUST HAD A MEETING AND DECIDED TO CHANGE YOUR PROJECT SUBSTANTIALLY.



S. Adams

WE DIDN'T INVITE YOU TO THE MEETING BECAUSE THINGS GO SMOOTHER WHEN NOBODY HAS ANY ACTUAL KNOWLEDGE.

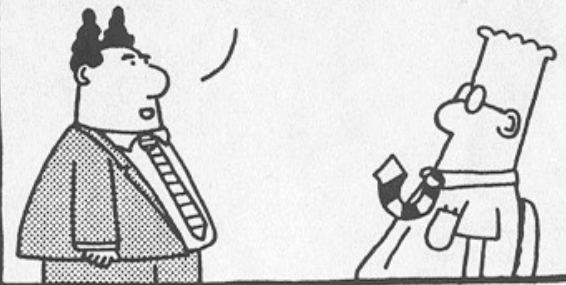


5-21

© 1994 United Feature Syndicate, Inc.

SO, WHAT ARE THE CHANGES?

IF I REMEMBER I'LL LEAVE YOU A VOICE MAIL.



Key Tasks for an Analogy

- Identify unusual requirements
- Obtain reliable data on the historical data point
- Obtain scaling factors from qualified functional experts
- Look at differences in manufacturing technology
- Address size and volume constraints
- Obtain justification for a range of scaling factors

The Basic Types of Estimating Methodology

- Analogy
- **Catalog Prices/Vendor Quotes**
- Extrapolation From Actuals
- Factor/Ratio
- Grassroots/Bottoms-up
- Manloading
- Parametrics

The Catalog Pricing/Vendor Quotes Methodology

- Whenever you have off-the-shelf hardware or software, use this methodology.
- Do not restrict its use to Prime Mission Product items. This methodology can be equally effective for off-the-shelf peculiar support equipment or off-the-shelf training equipment, etc.

Type of Information Required for Catalog Pricing/Vendor Quotes

- Specific identification of hardware/software items
- Prime's loading on subcontract/purchased efforts
- Price decreases anticipated in future years
- COTS software license terminology

Type of Information Required for Catalog Pricing/Vendor Quotes_(cont'd)

- Degree of subcontracting
- Sole-source environment
- Competitive discounts
- Quantity information
- Quantity discounts

Credible Sources of Data for Catalog Pricing/Vendor Quotes

- Functional Experts
- Vendor Catalogs
- Telecons with Vendors
- Loadings
 - Defense Contract Audit Agency (DCAA)
 - ESC/FMC Study on Prime Loadings
 - Specific Loadings for Known Prime Contractors

Special “Watch Areas” for Catalog Pricing/Vendor Quotes

- Specific quantity information
- Prime loadings on subcontracted items
- Multiple tiers of loadings
- Range of costs for likely vendors
- Scope

The Basic Types of Estimating Methodology

- Analogy
- Catalog Prices/Vendor Quotes
- **Extrapolation From Actuals**
- Factor/Ratio
- Grassroots/Bottoms-up
- Manloading
- Parametrics

Extrapolation From Actual Costs To Date

- Take the actual cost to date and divide it by the functional expert's estimate of percent complete (from a cost perspective).

Example:

$$\frac{\$3\text{M}}{.40} = \$7.5\text{M}$$

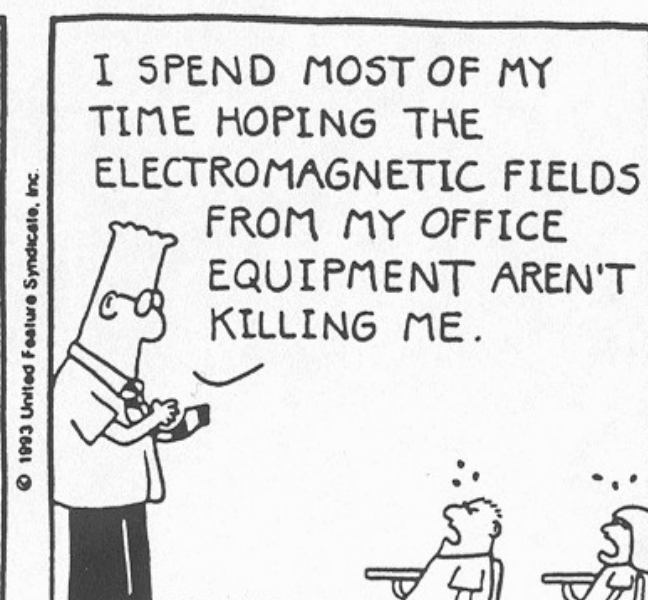
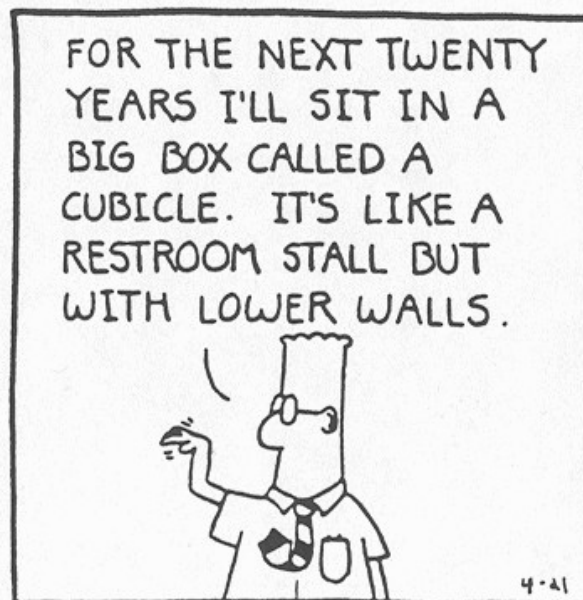
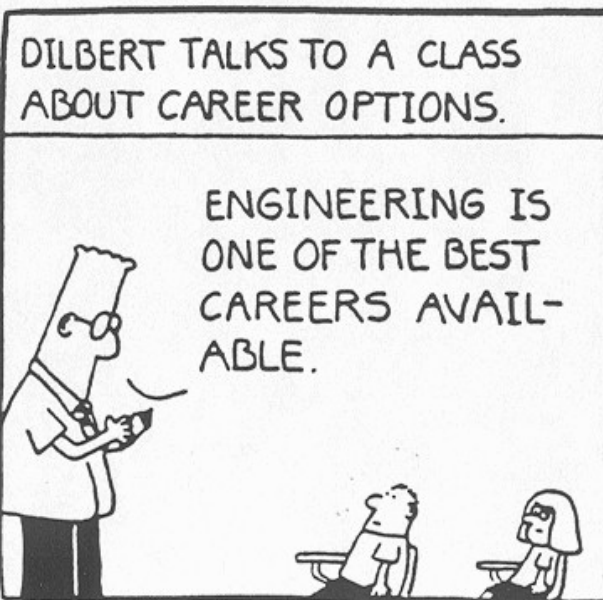
$$\frac{\$3\text{M}}{.60} = \$5\text{M}$$

When to Use Extrapolation From Actuals

- Can you obtain the data required from credible sources?
- Has a sufficient percentage of total costs been incurred to date?
- Only use this methodology for single functional tasks.

Special “Watch Areas” for Extrapolations

- Percent complete from a COST perspective
- Task too difficult for experts to realistically estimate percent complete
- Point vs. Most Likely Range of percent complete
- Inexperienced/wrong functional specialist



The Basic Types of Estimating Methodology

- Analogy
- Catalog Prices/Vendor Quotes
- Extrapolation From Actuals
- **Factor/Ratio**
- Grassroots/Bottoms-up
- Manloading
- Parametrics

Factor/Ratio Methodology

- The dependent variable varies directly with the independent variable.
- The factor or ratio describes the relationship.

Example:

Indep. Variable	Variable	X	Factor/Ratio	=	Dep.
	PMP	X	20%	=	SE/PM

Information Required for Factor/Ratio

- Values for the dependent & independent variables from one or more similar efforts
- Enough technical, schedule & quantity data to ensure the efforts are actually similar
- Values for all the cost driving variables
- The independent variable for your effort must be within the range of the independent variables' values averaged to derive the factor

Credible Sources for Factor/Ratio

- Actual costs from contractor accounting systems and records, including contract cost data, schedule and technical reports
- NOT other cost estimates
- Functional specialists to confirm the similarity

Special “Watch Areas” for Factor/Ratio

- Only use when the independent variable values are approximately the same
- Make sure the factor or ratio is derived from an historical data point that is in fact similar
- Factor/Ratio may seem to be a simple methodology, but it requires a significant amount of research and analysis

The Basic Types of Estimating Methodology

- Analogy
- Catalog Prices/Vendor Quotes
- Extrapolation From Actuals
- Factor/Ratio
- **Grassroots/Bottoms-up**
- Manloading
- Parametrics

Grassroots/Bottoms-up Methodology

...is a detailed, functional labor and material estimate

- Labor hours and dollars are assessed for the relevant functional categories
- A material estimate is also developed at a very detailed level

Required Data & Credible Sources

- Most likely range for the detailed functional labor hours
- Detailed list of material requirements and quantities
- The cost of earlier production lots
- Experienced design, manufacturing, test and logistics engineers

Special “Watch Areas” for the Grassroots Methodology

- Availability of appropriate functional specialists
- Labor hour estimates from the wrong or inexperienced functional specialist
- Point estimates vs. most likely range
- Insufficient information about specific tasks
- Extrapolating from unreliable, earlier production lot costs

The Basic Types of Estimating Methodology

- Analogy
- Catalog Prices/Vendor Quotes
- Extrapolation From Actuals
- Factor/Ratio
- Grassroots/Bottoms-up
- **Manloading**
- Parametrics

Manloading Methodology

...is basically a manpower analysis.

- Calculate how many people are required for a specific duration.
- Multiply the resulting staff-hours or staff-months by the appropriate labor rate.

Components of Manloading

- Labor categories/skill mix and associated hours; Examples of labor categories:
 - Senior Engineers
 - Engineers
 - Software Technicians
 - Senior Programmer
 - Junior Programmer
 - Assembler
 - Administrative Support
- Labor rate

Sources of Labor Rates

Direct Labor Analysis Model (DLAM)

- part of ACEIT
- direct labor category definitions and their direct labor rates by skill category and geographic region
- based on periodic Bureau of Labor Statistics (BLS) salary surveys

Sources of Labor Rates

(cont'd)

- DCAA at the Contractor's plant or locality
- ESC Procurement Pricing Office
- SPO Procurement Contracting Officer

The Basic Types of Estimating Methodology

- Analogy
- Catalog Prices/Vendor Quotes
- Extrapolation From Actuals
- Factor/Ratio
- Grassroots/Bottoms-up
- Manloading
- **Parametrics**

Parametric Methodology

...estimates cost as a mathematical function of one or more causal independent variables

- A homogeneous family of data points is collected and analyzed.
- A statistical analysis is done to find a relationship between the data points.
- The resulting parametric is an equation that estimates cost as a function of one or more variables.

Information Needed to Develop a Parametric Equation

- Reliable historical cost, schedule and technical data on a set of data points
- Information on the cost, technical and quantity drivers
- Realistic and reliable parameters for your particular independent variables

Information Needed to USE a Parametric Equation

- Parametric must be well-documented.
- The Mean Absolute Deviation (MAD)
- Realistic, most likely range estimates for the independent variables
- Functional experts should confirm the applicability of the specific parametric from a technical perspective

Special “Watch Areas” for Parametrics

- Database range
- Research & validate
- Adjustment
- Realistic estimates of independent variables
- Point vs. range

7 Steps of the Cost Estimating Process

1) Define and Plan

2) Specify Estimating Methodology

3) Calculate -- Including What-ifs & Alternatives

4) Time Phase in Base Year Dollars

5) Inflate to Then Year Dollars

6) Wrap Up Documentation

7) Complete Final Reviews